

REMARKS

Claims 1 and 4-22 are all the claims pending in the application. Claims 2 and 3 are cancelled and claim 22 is added by way of this Amendment. Claims 12-20 presently stand withdrawn as being drawn to a non-elected invention.

Drawings

It is noted that the Summary page of the Office Action indicates that the drawings filed October 15, 2003 are objected to. No detailed remarks are provided by the Examiner explaining the objections. Moreover, the previously filed drawing changes (April 29, 2005) are believed to obviate any objections made in the previous Office Action. Thus, no response is believed to be in order at this time regarding the drawings.

Specification Objections

The specification is objected to by the Examiner as failing to provide proper antecedent basis for claims 11, 10 and 21.

With respect to claim 11, Applicants amend page 5 of the specification to clarify that the shafts are rotatable with respect to each other. Moreover, one of ordinary skill in the art would have understood that the input and output shafts are rotatable with respect to each other, and thus, the originally filed application fully supports and enables this feature. In view of the foregoing, the objection of claim 11 should be withdrawn.

With respect to claim 10, the second paragraph on page 9 of the specification currently states "A concave 2f is formed at the position of intersection of two grooves 2d, 2e, an opening edge of which forms an acute angle of $\alpha < 90^\circ$ by forming axial groove 2e of rectangular section in input shaft 2 of circular cross section..." In addition, Fig. 11 illustrates the axial groove 2e

having an opening edge formed at an acute angle α , which is inherently formed by the nature of a rectangular cut-out on a circular cross-section. Thus, the specification provides antecedent basis for this claim language. In view of the foregoing, Applicants respectfully request the Examiner to reconsider and withdraw this objection to claim 10.

With respect to claim 21, the paragraph bridging pages 13-14 and the second paragraph of page 14 of the originally filed specification explain and provide proper antecedent basis for the claim language that “the cylindrical member is loosely fitted to the shaft member except the caulked portion.” As described in these portions of the specification, “since a slight clearance exists between inner-periphery-side cylinder 60 and maximum outer-diameter portion 2c of input shaft 2, surrounding member 6 is loosely fitted to the outer periphery of maximum outer-diameter portion 2.” Still further, “part of inner-periphery-side cylinder 60 is driven into concave 2f by caulker 81...so as to tightly engage circumferential and axial caulked parts 60a, 60b in circumferential groove 2d and concave 2f.” Moreover, a reading of the specification in its entirety shows support of how the cylindrical member 6 is loosely fitted to the shaft member 2, except in the caulked portions. See page 16, for example. Thus, the originally filed specification clearly describes and provides antecedent basis for the claim language of claim 21. In view of the foregoing, Applicants respectfully request the Examiner to reconsider and withdraw this objection of claim 21.

§112 Rejections

Claims 4, 5, 10 and 11 are rejected under 35 U.S.C. § 112, second paragraph.

With respect to claims 4-5, Applicants amend claim 4 to overcome this rejection. The caulked portion is shown by 60a in Fig. 11 of the originally filed specification, and the

intersection of the axial groove and the circumferential groove is shown by 2f (2e) in Fig. 11. Namely, claim 4 is directed to the circumferential width of 60a versus a circumferential width (between opposed faces 2i) of the axial groove at the intersection. See page 10, lines 1-7 of the originally filed specification for support for the amendments to claims 4 and 5. In view of the changes to claim 4, this rejection of claims 4-5 should be withdrawn.

Turning to claim 10, the earlier discussion with respect to the specification objections clarify how the opening edge of the axial groove forms an acute angle. In particular, Fig. 11 illustrates the angle α , and the specification at page 9 discusses this feature. Thus, the rejection of claim 10 should be withdrawn.

Regarding claim 11, the input shaft and the output shaft of the present invention are positively claimed, and as explained in the specification, the shaft member earlier recited in the claims may be either an input shaft or an output shaft (penultimate paragraph of page 20 of originally filed specification). Since the claim positively recites the existence of an input shaft and an output shaft, and clarifies that the shaft earlier claimed is one of these input and output shafts, this claim further limits the structure. Thus, this rejection of claim 11 should be withdrawn.

Prior Art Rejections

Claim 21 is rejected under 35 U.S.C. § 102(b) as being anticipated by Chikaraishi (6,301,975).

Claims 1, 6, 7, 9 and 11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over newly cited Smith et al. (3,688,521) in view of Chikaraishi (6,301,975).

Claims 8 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith et al. (3,688,521) in view of Chikaraishi (6,301,975), and further in view of Fujioka et al. (4,716,756).

Claims 2, 4 and 5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith et al. (3,688,521) in view of Chikaraishi (6,301,975) and further in view of Krude et al. (4,202,184).

Claim 3 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith et al. (3,688,521) in view of Chikaraishi (6,301,975), and further in view of Krude et al. (4,202,184) and Jackman (2,913,290).

Analysis of Prior Art Rejections

Of the rejected claims, claims 1 and 21 are the only claims in independent form; therefore, the following discussion is initially directed to these independent claims.

Claim 1 is directed to a shaft member having an axial groove and a circumferential groove, and each groove has a cross section with opposed faces that are substantially parallel to each other. A cylindrical member is fitted to the shaft member and a caulked portion of the cylindrical member has a deformed inner surface in press contact with the opposed faces of the grooves at the intersection of the grooves. Claim 1 has been amended to include subject matter from claim 3 to clarify that the axial groove is greater in depth than the circumferential groove.

Smith discloses an axial groove 18 and a circumferential groove 21 which intersects the axial groove. An outer circumferential member 25 is press fit to the shaft member 26 at the intersection of the grooves.

The intersection of the axial groove and the circumferential groove of the shaft member is shown in Fig. 4, and the deepest part of the axial groove seems to be same in depth as that of the

circumferential groove. There is no explicit disclosure that the axial groove is greater in depth than the circumferential groove, as in amended claim 1.

In Chikaraishi patent, the intersection of the axial groove and the circumferential groove of the shaft member is shown in FIG. 2, and the circumferential groove is formed to be greater in depth than the axial groove.

As mentioned above, in amended claim 1 according to the present invention, the axial groove is greater in depth than the circumferential groove. Thereby, the part corresponding to the axial groove in the range of the part inwardly caulked at the intersection is further deformed (plastic deformation) to tightly engage with opposed faces of axial groove. Therefore, the cylindrical member's movement in its rotational direction can be suppressed. Especially, in a case where such a caulked portion is applied to a torque sensor, this feature "the axial groove is greater in depth than the circumferential groove" becomes more important since the positioning in the rotational direction is important. Thus, this structural arrangement is more than a mere "reversal of parts" as indicated in the outstanding Office Action.

Furthermore, in Jackman, although the axial groove is formed to be greater in depth than the circumferential groove is disclosed, the cylindrical member formed out of a material greater in linear expansion coefficient than that of the shaft member is not disclosed. Moreover, since the cylindrical member is divided (separated) at the caulked portion, the following effect and advantage obtained in the present invention cannot be produced. Namely, that the cylindrical member can be certainly connected to the shaft member even under a high temperature condition, since the caulked portion of the cylindrical member expands within the axial groove.

This effect, which cannot be obtained by the combination of the cited prior art, is supported by originally filed specification (see paragraph [0076] and thereafter).

Therefore, even if such a structure disclosed in Jackman patent is applied to Smith et al. and Chikaraishi, the effects according to the present invention cannot be produced. Furthermore, given the teachings of Smith and Chikaraishi, one of ordinary skill in the art would not have made the leap to combine the references as alleged in the Office Action, without the benefit of hindsight from the pending specification. There is no motivation in the cited references for combining the technologies, as alleged in the rejection.

In view of the foregoing, amended claim 1 is patentable.

Claim 21 is rejected as being anticipated by Chikaraishi alone. The Examiner argues that Chikaraishi discloses that all but the caulked portions are loosely fit. However, Fig. 5B shows that the end of the cylindrical member 10 is bent inward along its circumference so as to fit within the circumferential groove 12 along its entirety. With this structure, the cylindrical member is not loosely fitted to the shaft member except at the caulked portion (11) since it is also not loosely fitted to the shaft member at the end of the member 10 corresponding to the circumferential groove 12. In other words, the cylindrical member in Chikaraishi is in contact with the shaft member at the caulked portion and also at the other portion except the caulked portion, as shown in Fig. 5A.

In order to clarify the present invention according to claim 21, Applicants amend claim 21 to state that the cylindrical member is apart from the shaft member except the caulked portion. In other words, the (slight) clearance exists between the cylindrical member and the shaft member, as supported by the originally filed specification. Thereby, the cylindrical

member does not receive an excessive stress even if the cylindrical member shrinks due to a decrease in temperature.

In view of the foregoing, claim 21 is patentable.

The remaining rejections are directed to the dependent claims. These claims are patentable for at least the same reasons as claims 1 and 21, by virtue of their dependency therefrom. Moreover, these claims are patentable due to their own recitations contained therein.

For example, claim 9 is patentable for at least the same reasons as claim 21 above. In particular, the cylindrical member is apart from the shaft member except the caulked portion.

With respect to claim 10, Edgemon Jr. discloses teeth (axial groove by the examiner) which is rectangular in cross section, and teaches that the teeth have sharp top edges. However, reference numeral 18 pointed out by the examiner designates an arcuate surface 18 located at the bottom of straight sidewalls of the teeth. Moreover, in Edgemon Jr., the phrase "The teeth are generally rectangular in cross section and have the top portions 15 of their sidewalls generally perpendicular to the generally flat tops of the teeth" is described (col. 2, lines 1-4).

Namely, "perpendicular" is disclosed, but "acute angle ($< 90^\circ$)" is not disclosed nor suggested anywhere in Edgemon Jr. Therefore, the prior art rejection for claim 10 is unsupported. In the present invention, the advantage that the cylindrical member can be more strongly fixed by this feature "acute angle ($< 90^\circ$)", is described at page 9, line 22-23 etc. of the originally filed specification.

Still further, Applicants note that the opening edge of the axial groove is designed to have an acute angle so as to produce this advantage, and hence this feature is important for fixing the cylindrical member strongly at the intersection, in the present invention.

AMENDMENT UNDER 37 C.F.R. § 1.116
U.S. Appln. No. 10/684,684

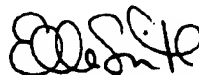
Applicants add new claim 22 to recite the feature that the opening edge of the acute angle exists at the intersection. Since this feature is not taught or suggested by the cited prior art, claim 22 is patentable.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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